surface to depths of 3–5 km, particularly in the northern lowlands where the surface roughness is low. MARSIS deployment in March 2005 will provide the best opportunity to collect subsurface data for much of the northern lowlands.

Understanding the deep internal structure will ultimately require seismic data and a mission like the now defunct Mars NetLander. A critical area for future work that was identified is modeling of basin-scale impacts to determine if the observed difference in crustal thickness can be accounted for by multiple impacts. Our understanding of the effects of giant impacts on crustal structure is in an embryonic stage.

The "Hemispheres Apart" Workshop was held on 30 September–1 October 2004 at the Lunar and Planetary Institute in Houston, Texas.

Acknowledgments

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The International Water Cycle Workshop

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Scientists from Japan, Europe, and the United States met at the International Water Cycle Workshop, in Seattle, Washington, last summer. The goals of this workshop were to review a draft implementation of the water cycle component to the Global Earth Observing System of Systems (GEOSS), and to develop a companion "water cycle road map" that would provide specific actions and timetables for its implementation.

This meeting was an outcome of the 10th U.S.-Japan Workshop on Global Change, Climate and Water, held in Irvine, California, in January 2003, and the Group of Eight (G-8) Earth Observing Summits I and II. The meeting was timed to align with the G-8 GEOSS Implementation Plan expert review period (15 July to 25 August 2004).

Earth Observation (EO) Summit I, held on 31 July 2003 in Washington, D. C., promoted the development of a comprehensive, coordinated, and sustained Earth observation system, including the conceptual framework and implementation plan for such a system (http://www.earthobservationsummit.gov/). This summit was followed by the G-8 Action on Science and Technology for Sustainable Development, which included a commitment to strengthen international cooperation on global observations and strategies for the next 10 years; to identify new observations to minimize data gaps; to build on existing work to produce reliable data products on atmosphere, land, fresh water, oceans, and ecosystems; to improve the worldwide reporting and archiving of these data and fill observational gaps of coverage in existing systems; to favor interoperability with reciprocal data-sharing; and to develop an implementation plan to achieve these objectives.

EO Summit II, held on 25 April 2004 in Tokyo, Japan, began to develop a 10-Year Implementation Plan (TYIP) that will be presented at Earth Observation Summit-III in Europe in early 2005. At EO Summit-II, a framework document was developed, agreed upon, and adopted for Earth observations. The document includes an implementation of in situ measurements, satellite observations, and modeling systems for "achieving comprehensive, coordinated, and sustained Earth observations for the benefit of humankind."

The International Water Cycle Workshop reached the following overarching conclusions and recommendations with regard to the water cycle activities of GEOSS, all of which were incorporated into the expert review.

1. The GEOSS must have international data-sharing and exchange agreements with all nations that wish to be members. These agreements would specify that the GEOSS-required data and related metadata be made available in a timely manner to GEOSS regional and central data centers that would then distribute the data to the GEOSS community. There would be no costs borne by GEOSS for the acquisition of these data.

The members of the workshop noted that global hydrologic data are at present neither freely nor openly available, and that this is a major impediment to global water cycle research and affects the exchange of information about the status of the world's water resources. GEOSS has been encouraged to adopt an open data policy and to consider this workshop's option as one way to achieve this goal.

2. For GEOSS to fulfill its goals of providing data products for water decision-making, it must establish data and modeling synthesis centers. These centers would receive data from national data centers operating in situ data networks, climate data from national and international climate data centers, remote sensing data and products from operational remote sensing data centers, data from the GEOSS water reference sites, and experimental data collected under international programs such as the WCRP.

GEOSS needs to work with space agencies in developing priorities and specifications for new and enhanced space-based observations. The GEOSS synthesis centers would host process and management water cycle models; assimilate the above data into models; develop data products, including real-time data-based products; and make predictions in support of water-related decision-making. The workshop recognized the potential of the Coordinated Enhanced Observing Period (CEOP) data center at the University of Tokyo to serve as one of these GEOSS synthesis centers but encouraged governments and GEOSS to develop more centers.

3. To better ensure that the GEOSS 10-year implementation plan goals are met, demonstration projects need to be funded in the early stages of the implementation period. These projects need to test components of the end-to-end GEOSS data, modeling, and decision support system. The projects need to show the relevance of the GEOSS products to local and regional water management decision-making, with an emphasis on value-added data products for data-poor locations. GEOSS and the IGOS-P Global Water Cycle Observations (IGWCO) theme have been encouraged to use demonstration projects as part of their capacity-building activities.

4. GEOSS should give capacity-building a central role in its implementation. Capacity-building is essential for GEOSS to ensure the commitment of developing countries and maximize the benefits that humanity derives from its implementation. Through early pilot capacity-building projects, the benefits of GEOSS data will be demonstrated. Capacity-building will also include major upgrades in the hardware and software available in developing countries. It will provide training programs that will allow their water managers to acquire the training and "hands-on" experience needed to improve regional observing networks, and to analyze and interpret the products developed from these observations. GEOSS has been encouraged to adopt a comprehensive capacity-building strategy.

5. The workshop recognizes that many of the water cycle issues raised above are relevant to other GEOSS groups, and a framework for discussion with these groups needs to be developed by GEOSS. Participants at the workshop expressed a willingness to assist GEOSS by participating in such a framework.

GEOSS must facilitate the enhancement of data products for decision makers by utilizing a greater range of data and by increasing the interaction and collaboration between data providers, modelers, and users. The needs for data exchange and regionalization must be adopted as a critical underpinning for the GEOSS agreements and its governance process.

GEOSS should establish mechanisms that will give users a voice in indicating their priorities and provide them with opportunities to participate in GEOSS applications. Furthermore, the GEOSS structure must also facilitate the improved coordination of responsibilities and activities between the large number of international water projects and programs such as

the Global Water System Project, UNESCO International Hydrology Programme (IHP), and WCRP's Global Energy and Water Cycle Experiment. The ubiquitous nature of water ensures that the benefits of the broad application of these principles will accrue not only to the water sector, but to all sectors considered in the GEOSS plan. During the International Decade on Water for Life (2005–2015) it is hoped that members of the water community will commit to partnering with GEOSS as it implements its plan.

The workshop was attended by representatives from the National Aeronautics and Space Administration (NASA), European Space Agency (ESA), National Oceanic and Atmospheric Administration (NOAA), World Climate Research Programme (WCRP), UNESCO International Hydrological Programme (IHP), Global Energy and Water Cycle Experiment (GEWEX), Coordinated Enhanced Observing Period (CEOP), International Association of Hydrological Sciences (IAHS), IAHS Decade on Predictions in Ungaged Basins (PUB), Global Water System Project (GWSP), International Geosphere-Biosphere Programme (IGBP), Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI), Japan's Marine Science and Technology Center (JAMSTEC), and the Integrated Global Observing Strategy Partnership (IGOS-P). There were also representatives from a number of U.S., Japanese, and European universities and national laboratories.

The International Water Cycle Workshop was held in Seattle, Washington, 27–29 July 2004.

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The workshop hosts wish to thank Japanese and European colleagues for providing the opportunity to participate in the GEO process. Without their assistance, U.S. researchers would not have participated in this important review and road map process.

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MYRES: A Program to Unite Young Solid Earth Researchers

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The first Meeting of Young Researchers in the Earth Sciences (MYRES-I), held in August of 2004, focused on "Heat, helium, hotspots, and whole mantle convection." Biennial meetings, with MYRES-I as the first, are one of the ways the MYRES initiative is building an "international, interdisciplinary, open and unbiased community of colleagues who interact regularly to informally exchange ideas, data, and tools, and formulate new collaborative research projects" (see *Young Solid Earth Researchers of the World Unite*! published in *Eos, 85*(16), 160, 2004). This article reports on our first workshop, discusses what is happening in the community, and calls for proposals to keep MYRES funded.

A New Meeting Concept

The MYRES meetings are organized by, and for, junior members of the solid Earth research community. In 2004, funding from the U.S. National Science Foundation (NSF), the European Science Foundation (ESF) and the Scripps Institution of Oceanography enabled the initiative to nearly fully fund this meeting with a diverse and international crowd of nearly 100 participants selected from an oversubscribed pool.

MYRES was founded on the idea that through thorough and critical exposure to each other's thinking, young researchers can avoid becoming overspecialized and perpetuating entrenched views. Thus, the eight keynote presentations were conceived primarily as tutorials aimed at familiarizing practitioners of one research area with the results and cross-disciplinary implications of another. Presentations were reviewed in advance by all lecturers to maintain a coordinated focus. Fully referenced and annotated slides, some with a glossary of jargon, were made available before the meeting on the MYRES Web page, where they remain accessible today.

In line with the promise of being "open and unbiased," special attention was paid to exposing the pitfalls, misconceptions, and presumptions that all too often reinforce existing boundaries between research domains and impede a sound interpretation of the progress made in the field as a whole.

The integrative approach of the first MYRES workshop allowed the participants to formulate scientific questions that require a multifaceted, collaborative approach and long-term vision.

Answering Questions on the Structure and Evolution of Earth's Mantle

What is the convective style of the Earth's mantle? Does the mantle convect as a whole, or is it layered? How is heat transport organized in the Earth? Do mantle plumes exist? What is their contribution in delivering Earth's heat to the surface? What are the origins and correlation length scales of mantle heterogeneity? What is the nature and role of geochemical reservoirs? Is there an undifferentiated reservoir in the lowermost mantle?

These questions do not stand alone; they require interdisciplinary solutions involving geochemical, seismological, and geodynamical observations and models. Thus, in addition to mastering one's own disciplines, it is necessary to know more than "just enough to be convinced" by evidence from other areas arguing one way or another on such important questions.

Researchers must know enough to be able to challenge each other's views and interpretations and to incorporate the progress made in another discipline into one's own research. This requires, at the very least, understanding the uncertainties of the data collected and of the models derived by one's colleagues.

Communicating Uncertainty Across Disciplines

Calculating, representing, and then conveying the uncertainty in a seismic mantle model, for example, such that it can be meaningfully interpreted by others, is a daunting task. Uncertainties in the observations can at best only be estimated, as the distribution of the errors is usually unknown.

However, the uncertainty in the models based on these data is almost always out of reach, owing to the sheer size of the model space of the unknowns. Moreover, large models with many parameters derived from limited observations are invariably non-unique.

Geophysical inverse theory, statistics, and advanced visualization techniques make the uncertainty problem tractable to some extent, but the "best model," fundamentally, is subjective. As a consequence, model users (e.g., the geodynamicist wanting to predict dynamic topography or calculate the driving forces for mantle convection from seismic wave speeds, or the mineral physicist wishing to interpret wave speed heterogeneity in terms of mantle temperature) almost inevitably need access to the scientist constructing the model.

Small meetings provide this opportunity, and small meetings focused on the junior members of the academic hierarchy (students, postdocs, and untenured faculty), such as MYRES, are able to do this extremely well.

Mantle Structure: Inference and Interpretation

The MYRES-I workshop opened with a discourse on "Seismic tomography: Art or science?," mixing answers to questions regarding mantle structure with further questions on how to represent and interpret model uncertainties. Art and science, the subjective and the objective, are linked in the construction of mantle models from seismic observations. The attendees were taught to evaluate the robustness and uniqueness of such models by critically evaluating data coverage, inversion damping, and issues regarding the measurements themselves.

Such problems are not unique to seismology. The second tutorial lecture, "How to interpret geophysical data for mantle dynamics," discussed the sources of error in measuring mineral physics constants and their conversion to other geophysical observables. "Constraints on mantle structure from surface observables"